occurred, subsequent LLC PDUs can continue to be saved, as indicated in the step 920, until correct reception is achieved. Rather than having an endless loop in case of never receiving a correct LLC PDU with UPTM, a mechanism can be inserted (not shown) to stop same from going on forever. Such could be a timer which, upon timing out, would allow exit from the loop and a transition to the step 918 for continued operation normally (as before).

Transceiver

Figs. 10A and 10B show a transceiver apparatus which can be used as both a transmitter on the transmitting side or a receiver on the receiving side. It includes a means 1000 for transmitting and receiving info packets over a wireless interface. An interface bus 1002 is directly connected to an air interface, for example, by means of an antenna (not shown). An internal bus 1004 is connected to various blocks shown in Fig. 10 and to other internal blocks (not shown) of a receiving section or a transmitting section, as the case may be. I.e., the various blocks of Figs. 10A and 10B are shown in two sections, a transmitting section 1006 and a receiving section 1008. The transmitting section 1006 includes means for determining a selected packet 1010, i.e., corresponding to the step 802 of Fig. 8A, wherein it is determined whether a UPTM is associated with a PDU on the bus 104. This may mean detecting an LLC PDU that already has a UPTM associated therewith, or it may mean actually associating the UPTM to a given PDU, or the like. In any event, the means 1000 transmits the selected LLC PDU on the bus 1002, over the air interface to the receiving side, which also has apparatus similar to that shown in Figs. 10A and 10B. The receiving section 1008 on the receiving side, while receiving packets, will determine by means 1012 whether there is a selected LLC PDU incoming, and whether it was received correctly, as per steps 902, 904, 908 of Fig. 9A. It will determine by

means 1014 whether the incoming packet requires an acknowledgement. It will use means 1016 to acknowledge (or negatively acknowledge) receipt back to the transmitting side over the air interface.

Back on the transmitting side, means 1018 will receive the acknowledge message and provide an indication of reception thereof to means 1020 that has been waiting, as per the timer started in step 806 of Fig. 8A for such acknowledgement. Such means 1020 implements, for example, the decision block 820 of Fig. 8B and the decision block 824 of Fig. 8A. Similarly, the means 1018 implements, for instance, the decision steps 816, 826 of Fig. 8B.

As has already been mentioned in connection with the description of Figs. 8A and 8B, there are cases where it is desired to save the selected LLD PDU as well as subsequent PDUs until positive acknowledgement is received back from the receiving side. This storage function can be carried out by the means 1022, 1024, as shown in Figs. 10A and 10B. In the event that positive acknowledgement is not received back before the timer function 1020 times out, the means 1020 can signal a means 1026 to retrieve the stored LLC PDU from the means 1022 and the normal packets from the means 1024 for retransmission on the bus 1002 to the receiving means. In this way, the retransmission function of Figs. 8A and 8B is carried out by the transmitting section 1006 of the transceiver means of Figs. 10A and 10B. As mentioned, this transceiver means will be present on both sides of the wireless interface, i.e., in both the transmitting side equipment and the receiving side equipment. Since both sides perform both functions, depending on which side is initiating the transfer, the particular side in which the transceiver resides is not specified in Figs. 10A and 10B.

RLC block acknowledgement

One of the following mechanisms, among others, may be used to provide acknowledgement information to the transmitting side.

RLC acknowledgement message bitmap

In GPRS, according to the present invention, regardless of whether RLC acknowledgement (ACK) or RLC unacknowledgement (UNACK) blocks are being transmitted, the network and the MS keep sending acknowledgement messages (e.g., Packet Uplink/Downlink ACK/UNACK) containing acknowledgement including ACK bitmaps which contain valid acknowledgement information either always (in acknowledge mode), or only in cases when an important LLC PDU is being transferred (modified unacknowledge mode).

When UNACK RLC data blocks are being transmitted, the bitmap doesn't contain valid information in the current evolution of GPRS (but is still included into ACK messages) but the ACK message is used for control purposes: when receiving ACK message, the other peer knows its connection is still OK, and the other side is also able to transfer some control information (e.g., measurement) in the ACK message. See Chapter 9 of European Standard Draft EN 301 349 v7.0.0 (1999-07) entitled "Digital Cellular Telecommunications System (Phase 2+); General Packet Radio Service (GPRS); Mobile Station (MS)-Base Station System (BSS) Interface; Radio Line Control/Medium Access Control (RLC/MAC) protocol (GSM 04.60 version .0.0 Release 1998). So the invention can use as one mechanism to use these bitmaps (since they are being transmitted anyway) to obtain information about whether an important message was transferred successfully or not. Then there would be no need to use a separate procedure to ACK important messages. This may also be applied to other systems containing signaling procedures like GPRS.

Either by specification or information included in messages used to establish a TBF can be used to notify the peer RLC/MAC for the case where the acknowledgement bitmap contains always valid acknowledgement information when transferring otherwise unacknowledged RLC data in the TBF. The information included in messages used to establish the TBF may be, e.g., a new field in the Packet Resource Request message in case an UL TBF is being established or Packet Downlink Assignment message in case a DL TBF is being established.

In case the acknowledgement bitmap included in the Acknowledge message contains valid acknowledgement information only in cases when an important LLC PDU is being transmitted, the following mechanisms may be used:

- The RLC data block (either the first one, all or the last one) carrying important LLC PDU contains information that the receiving side shall acknowledge the received LLC PDU. In the first RLC data block, the segment to which the LLC PDU is placed into the RLC data block may be identified, because the RLC data block may contain multiple LLC PDUs in case they are short.
- The transmitting side shall notify the receiving side with a control message that an important LLC PDU is being transmitted after a short period. The message identifies the important LLC PDU, by containing, e.g., a BSN (Block Sequence Number) of the RLC block in which the LLC PDU transmission begins, so that the receiving side is able to determine which LLC PDU (which RLC data blocks) shall be acknowledged. Also, the message may identify the segment to which the LLC PDU is placed into the RLC data block, because the RLC data block may contain multiple LLC PDUs in case they are short.
- Another mechanism could be that a signaling message requesting acknowledgement is transmitted from the transmitting side to the receiving side after sending the important LLC PDU.

Control Message

The same procedures as described above apply in order to notify the peer RLC/MAC that a certain LLC PDU shall be acknowledged.

The acknowledgement of important LLC PDU takes place using a separate control message that contains enough information to (negatively) acknowledge an LLC PDU. The message may contain, e.g., BSNs of RLC data block containing the LLC PDU.

Although the invention has been shown and described with respect to a best mode embodiment thereof, it should be understood by those skilled in the art that the foregoing and various other changes, omissions and additions in the form and detail thereof may be made therein without departing from the spirit and scope of the invention.

Claims

1. Method for use in a telecommunications system having the capability to exchange information packets over a communications link in both an acknowledge mode in which reception by a receiver of all information packets transmitted by a transmitter over the communications link are acknowledged by the receiver sending at least one acknowledgement over the communications link back to the transmitter and in an unacknowledge mode in which none of the information packets transmitted by the transmitter over the communications link are acknowledged by the receiver, characterized by said transmitter in said unacknowledge mode nevertheless determining from among a plurality of packets destined for transmission to the receiver in said unacknowledge mode a selected packet for which an acknowledgement of receipt from the receiver is required, and signaling said receiver that said acknowledgement of receipt of said selected packet is required from the receiver.

2. The method of claim 1, further characterized by said transmitter after transmitting said selected packet, waiting during a set time period thereafter for receipt of said acknowledgement from said receiver before taking further steps contingent on said acknowledgement of receipt by said receiver.

3. The method of claim 2, further characterized by said transmitter storing the selected packet during said set time period at least until said receipt of said acknowledgement from said receiver.

4. The method of claim 3, further characterized by said transmitter, after said selected packet is transmitted to the receiver, also storing during said set time period packets for which acknowledgement is not required at least until said receipt of said acknowledgement from said receiver.

5. The method of claim 4, further characterized by said transmitter retransmitting to said receiver said stored selected packet and said stored packets for which acknowledgement was not required after said set time elapses without receipt of said acknowledgement from said receiver.

6. The method of claim 3, further characterized by said transmitter retransmitting to said receiver said stored selected packet after said set time elapses without receipt of said acknowledgement from said receiver.

7. The method of claim 6, further characterized by said transmitter receiving over said communications link from said receiver an acknowledgement of receipt of said selected packet and by notifying a higher layer in a protocol stack of the transmitter of said receipt of said selected packet by said receiver.

8. The method of claim 6, further characterized by said transmitter waiting for at least one further set time period after said step of retransmitting said stored selected packet for an acknowledgement of receipt thereof from the receiver before finally concluding that said retransmitted stored selected packet was not received by the receiver.

9. The method of claim 8, further characterized by said transmitter notifying a higher layer in a protocol stack of the transmitter of nonreceipt of said retransmitted stored selected packet.

10. The method of claim 5, further characterized by said transmitter waiting for at least one further set time period after said step of retransmitting said stored selected packet and said stored packets for which acknowledgement was not required, for an acknowledgement of receipt of the stored selected packet from the receiver before finally concluding that said retransmitted stored selected packet was not received by the receiver.

11. The method of claim 10, further characterized by said transmitter notifying a higher layer in a protocol stack of the transmitter of nonreceipt of said retransmitted stored selected packet.

12. The method of claim 2, characterized by said transmitter concluding after lapse of said set time period without receiving said acknowledgement that said selected packet was not received by said receiver.

13. The method of claim 12, further characterized by said transmitter notifying a higher layer in a protocol stack of the transmitter of nonreceipt of said acknowledgement.

14. The method of claim 1, characterized by said receiver in said unacknowledge mode determining reception over said communications link of said selected packet for which acknowledgement of receipt is required, and signaling said acknowledgement of receipt to said transmitter over said communications link.

15. The method of claim 14, characterized by said receiver determining whether said received selected packet was received correctly or not wherein said step of signaling said acknowledgement of receipt to said transmitter indicates correct or incorrect reception.

16. The method of claim 15, characterized by said transmitter storing the selected packet during said set time period at least until receipt of said acknowledgement from said receiver and upon receipt by said transmitter of said acknowledgement indicative of incorrect reception of said selected packet, retransmitting said selected packet.

17. The method of claim 15, characterized by said receiver, after determining the selected packet was received incorrectly, continuing to process incoming packets without any change in processing method therefor.

18. The method of claim 15, characterized by said receiver saving packets received after determining the selected packet was received incorrectly until receiving the selected packet correctly after which the receiver processes incoming packets according to a method identified by said selected packet.

19. The method of claim 1, characterized by said transmitter receiving over said communications link from said receiver an acknowledgement of receipt of said selected packet and by notifying a higher layer in a protocol stack of the transmitter of said receipt of said selected packet by said receiver.

20. Transceiver having a receiving section and a transmitting section for use on both a receiving side and a transmitting side in a communications telecommunications system having the capability to

exchange information packets over a communications link in both an acknowledge mode in which reception by a receiver section of a transceiver on the receiving side of all information packets transmitted by the transmitter section of a transceiver on the transmitting side over the communications link are acknowledged by the receiver section sending at least one acknowledgement over the communications link back to the transmitter section and in an unacknowledge mode in which none of the information packets transmitted by the transmitter section over the communications link are acknowledged by the receiver section, characterized by said transmitter section in said unacknowledge mode nevertheless having means for determining from among a plurality of packets destined for transmission to the receiver section in said unacknowledge mode a selected packet for which an acknowledgement of receipt from the receiver section is required, and means for transmitting a signal to said receiver section that said acknowledgement of receipt of said selected packet is required from the receiver section.

21. The transceiver of claim 20, further characterized by said transmitter section receiving over said communications link from said receiving side an acknowledgement of receipt of said selected packet and by notifying a higher layer in a protocol stack of the transceiver of said receipt of said selected packet by said receiving side.

22. The transceiver of claim 20, further characterized by said transmitter section having means for waiting during a set time period after transmitting said selected packet for receipt of said acknowledgement from said receiver section before taking further steps contingent on said acknowledgement of receipt by said receiver section.